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# TOPICAL OUTLINES

# FOR THE

# PROPOSED GRADUATE COURSES

## ADVANCED SEMINAR

This proposed course is the graduate mate to the existing 1905.450 Seminar I Course.

The student is required to present two or three seminars on topics chosen from current scientific literature at the graduate level. Initial seminars are presented by faculty with discussion of effective techniques. All seminars are accompanied by 35 mm slides prepared by the student. Attendance at monthly South Jersey American Chemical Society meetings is required.

The distinction between this proposed course and Seminar I is in the level of material presented. A student in Advanced Seminar would present, orally and in writing, topics discussed in the most recent and discerning journals. Evaluation of the presentations would be at the graduate level of expectation.

## ORGANIC REACTIONS AND MECHANISMS

This proposed course is the graduate mate to the existing 1907.465 Advanced Organic Chemistry Course. The following topical outline is common to both these courses:

1. Survey of the classes of organic compounds.
2. Resonance, Molecular Orbital Theory, Aromaticity.
3. Organic Reactions, survey.
4. Nucleophilic substitution at saturated carbon.
5. Synthetic uses of nucleophilic substitution.
6. Nucleophilic addition, carbonyl and related groups.
7. Nucleophilic substitution at unsaturated carbon; carbonyl and related groups.
8. Elimination reactions.
9. Electrophilic additions to multiple bands.
10. Molecular rearrangements.

While the objective of the undergraduate course is principally to develop basic knowledge of theory and skills necessary for the student to read, with understanding, the basic technical literature and perform the basic laboratory procedures in this field; the graduate student would be required to perform graduate level laboratory experiments and/or research in the literature with the objective of developing advanced knowledge of theory, advanced skill in methods, and research capabilities. The topics chosen to assist in the development of advanced competencies would be arrived at through consultation between student and instructor. Suggested topics for graduate projects are:

a. A literature search for the multistep synthesis of a complex organic compound and development of specific laboratory procedure to perform such a synthesis.
b. HMO theory and its application to organic reactions.
c. Carbene chemistry; a survey of methods for generating carbenes and the use of carbene in organic syntheses.
d. A survey of the chemistry of free radicals.
e. Carbonium ion chemistry; their generation and utilization in organic chemistry.
f. The chemistry of organophosphorous compounds.

Evaluation of the additional graduate level objectives would be based on the laboratory reports and research papers written to satisfy the graduate requirements of the course.

## ORGANIC ANALYSIS

This proposed laboratory course is the graduate mate to the existing 1907.470 Organic Qualitative Analysis Course. The objective of both of these courses is is to develop the student's ability to identify organic compounds through the use of the following eight fundamental steps carried out in sequence:

1. Preliminary examination of physical and chemical characteristics.
2. Purification and determination of physical constants, i.e., melting point, boiling point, density.
3. Elementary analysis; sodium fusion test.
4. Solubility tests, including acid-base properties.
5. Infrared spectrum; functional group analysis.
6. Classification tests; functional group determination.
7. Preparation of derivatives: organic structure determination
8. NMR spectrum: organic structure confirmation.

While both the undergraduate and the graduate student is required to use the above procedures to:

1. Identify at least three unknowns:
    a. aldehyde or ketone unknown
    b. general liquid unknown
    c. general solid unknown, and
2. Perform a separation and identification of a mixture of two unknowns;

the graduate student is required to perform additional identifications and separations, using more sophisticated techniques, with the objective of developing advanced skills in methods and research capabilities. The topics chosen to assist in the development of advanced competencies would be arrived at through consultation between student and instructor. Suggested topics for graduate projects are:

a. Identification of an additional unknown organic compound by classical organic analysis.
b. Separation of a mixture of several organic compounds, and the identification of each compound of the mixture.
c. Identification of an unknown organic compound by the use of spectroscopy.
d. Demonstration of a knowledge of mass spectroscopy and the ability to interpret mass spectra.

Evaluation of the graduate level component would be based on the laboratory results and the written reports performed in connection with the graduate projects.

# INSTRUMENTAL ANALYSIS

This proposed course is the graduate mate to the existing 1909.410 Instrumental Methods Course. The following topical outline is common to both these courses.

A. Electromagnetic Radiation and its interaction with matter.

1. Properties of electromagnetic radiation
2. Interaction with matter
3. Emission of radiation

B. Techniques and tools for the measurement of absorption of ultraviolet and visible radiation.

1. Quantitative aspects of absorption measurements
2. Components of instruments for absorption measurements
3. Instrument design

C. Applications of ultraviolet and visible absorption measurements.

1. Absorbing species
2. Qualitative analysis
3. Quantitative analysis by absorption
4. Photometric titrations
5. Spectrophotometric studies of complex ions

D. Atomic Absorption Spectroscopy

1. Principles
2. Instruments
3. Applications

E. Infrared Spectroscopy

1. Theory of infrared abosrption
2. Infrared instrumentation
3. Sample handling techniques
4. Qualitative application of infrared
5. Quantitative applications

F. Nuclear Magnetic Resonance Spectroscopy

1. Theory of NMR
2. Experimental methods
3. Applications of 'H NMR to structural studies
4. Other applications of NMR spectroscopy
5. Electron spin resonance

G. Fluorescence Spectrometry

1. Theory of fluorescence
2. Measurement of fluorescence
3. Applications of fluorometry

H. Emission Spectroscopy

1. The emission process
2. Emission instruments
3. Determination of live intensities
4. Applications

I. Flame Emission Spectroscopy

1. Flame and flame spectra
2. Flame characteristics
3. Flame spectrophotomers
4. Quantitative analysis by flame emission spectroscopy
5. Inductively coupled ion plasma spectroscopy

J. Refractometry

1. General principles
2. Instruments
3. Applications

K. X-Ray Methods

1. Fundamental principles
2. X-Ray instrumentation
3. X-Ray emission methods
4. X-Ray absorption methods
5. X-Ray diffraction methods

L. Mass Spectroscopy

1. Fundamental principles
2. Instrumentation
3. Mass spectra
4. Qualitative applications of mass spectroscopy
5. Quantitative applications of mass spectroscopy

M. Introduction to Electroanalytical Chemistry

1. Electrochemical cells
2. Electrode potentials
3. Cell potentials
4. Common cells and half cells

N. Potentiometric Methods

1. Metallic indicator electrodes
2. Membrane electrodes
3. Instruments for measurement of cell potentials
4. Applications of direct potentiometric measurement
5. Potentiometric titrations

O. Conductometric Methods

1. Electrolytic conductance
2. Measurement of conductance
3. Conductometric titrations

P. Electrogravemetric Methods

1. Current-voltage relationships during an electrolysis
2. Effects of experimental variables
3. Instrumentation
4. Applications

Q. Voltammetry

1. Polarography
2. Applications of polarography
3. Amperometric titrations

R. Chromatographic Methods

1. Nature of separation process
2. Counter current extraction
3. Chromatographic separations
4. Methods with liquid mobil phase
5. High performance liquid chromatography

S. Gas-Liquid Chromatography

1. Principles
2. Instrumentation
3. Effect of instrument variables on separation
4. Applications

While the objective of the undergraduate course is principally to develop basic knowledge of theory and skills necessary for the student to read, with understanding, the basic technical literature and perform the basic laboratory procedures in this field; the graduate student would be required to perform graduate level laboratory experiments and/or research in the literature with the objective of developing advanced knowledge of theory, advanced skill in methods, and research capabilities. The topics chosen to assist in the development of advanced competencies would be arrived at through consultation between student and instructor.

Suggested topics for graduate projects are:

I. Radiochemical Methods

   A. Radioactive decay processes
   B. Radiation detectors
   C. Neutron a-tivation analysis
   D. Isotopic dilution methods
   E. Radiometric methods

II. Thermal Gravimetric Methods

III. Rotational Spectroscopy

   A. Generation and transmission of microwave energy
   B. Instrumentation
   C. Pure rotational spectra
   D. Analytical applications

Evaluation of the additional graduate level objectives would be based on the laboratory reports and research papers written to satisfy the graduate requirements of the course.

## BIOCHEMISTRY I - Lecture and Lab

This proposed course is the graduate mate to the existing 0414.348 Introduction to Biochemistry. The following topical outline is common to both these courses:

1. pH and Buffers
2. Cellular Morphology and Composition
3. Carbohydrate Chemistry
4. Lipid Chemistry
5. Protein Chemistry
6. Nucleic Acid Chemistry
7. Enzymes: Structure and Function
8. Biochemical Energetics
9. Carbohydrate Metabolism
10. Lipid Metabolism
11. Protein and Nucleic Acid Metabolism
12. The Tricarboxylic Acid Cycle
13. Photosynthesis
14. Biosynthesis of Carbohydrates and Lipids
15. Biosynthesis of Nitrogenous Compounds
16. Metabolic Control

While the objective of the undergraduate course is principally to develop basic knowledge of theory and skills necessary for the student to read, with understanding, the basic technical literature and perform the basic laboratory procedures in this field; the graduate student would be required to perform graduate level laboratory experiments and/or research in the literature with the objective of developing advanced knowledge of theory, advanced skill in methods, and research capabilities. The topics chosen to assist in the development of advanced competencies would be arrived at through consultation between student and instructor.

Suggested topics for graduate projects are:

a. Biochemistry of the brain

b. Biochemical functioning of the heart and muscle

c. Vitamins - their biochemistry and utilization in the metabolic processes

d. Hormones - their origin and biological function

e. Independent laboratory project

f. The eye - biochemistry of vision

Evaluation of the additional graduate level objectives would be based on the laboratory reports and research papers written to satisfy the graduate requirements of the course.

# MATHEMATICAL METHODS IN PHYSICS

This proposed course is the graduate mate to the existing 1902.425 Mathematical Physics Course. The following topical outline is common to both these courses:

I. Infinite Series

1. Definitions
2. Convergence and divergence
3. Testing for convergence
4. Power series
5. Expansion of functions in power series
6. Some uses of series
7. Uniform convergence

II. Complex Numbers

1. Complex plane
2. Complex algebra
3. Complex infinite series
4. Complex power series
5. Powers and roots of complex numbers
6. Exponential and trigonometric functions
7. Hyperbolic functions
8. Logarithms and complex powers
9. Inverse trigonometric and hyperbolic functions
10. Applications

III. Determinants and Matrices

1. Cramer's rule
2. Laplace's development
3. Matrices
4. Linear dependence and independence
5. Rank of a matrix
6. Operations with matrices
7. Special matrices

IV. Partial Di-ferentiation and Multiple Integrals

1. Notation
2. Power series in 2 variables
3. Total differentials
4. Approximate calculations
5. Chain rule
6. Implicit differentiation
7. Maxima and minima problems
8. Boundary point problems
9. Change of variables
10. Differentiation of integrals
11. Applications

V. Vector Analysis

1. Notation
2. Vector addition
3. Multiplication of Vectors
4. Triple products
5. Lines and planes
6. Differentiation of Vectors
7. Directional derivative; gradient; normal derivative
8. Line integrals
9. Divergence and divergence theorem
10. Curl and Stoke's theorem
11. Surface integrals

VI. Fourier Series

1. Simple harmonic motion and wave motion
2. Periodic functions
3. Fowner coefficients
4. Dirichlet conditions
5. Complex form of Fourier series
6. Application to sound
7. Parseval's theorem

While the objective of the undergraduate course is principally to develop basic knowledge of theory and skills necessary for the student to read, with understanding, the basic technical literature and perform the basic mathematical procedures in this field; the graduate student would be required to perform graduate level study in the literature with the objective of developing advanced knowledge of theory, advanced skill in methods, and research capabilities. The topics chosen to assist in the development of advanced competencies would be arrived at through consultation between student and instructor. Several possible topics for graduate study are:

1. Fourier transforms
2. Laplace transforms
3. Special functions such as Legendre polynomials, Bessel functions, the Gamma function, etc.
4. Solutions of some partial differential equations of mathematical physics such as travelling waves, heat flow in a rod, and vibrations of circular membranes.

Evaluation of the additional graduate level objectives would be based on the papers written to satisfy the graduate requirements of the course.

## RADIOISOTOPE METHODOLOGY

This proposed course is the graduate mate to the existing 1904.465 Radiation Science Course. The following topical outline is common to both these courses:

I. Introduction to Theories of Radioactivity

   A. Historical Background

   B. Structure of matter

      1. Atomic structure

      2. Nucleus

   C. Nuclear Energetics and Reactions

II. Radiation Measurement

   A. Laboratory Safety and Regulations

   B. Preparation of Samples and Operation of G. M. Counters

III. Statistics

   A. Introduction - Errors, Statistical Parameters, Data Distribution

   B. Gaussian or Normal Curve

   C. Applications of Statistics to Radioactive Counting

IV. Radioactive Decay

   A. Modes

   B. Decay Schemes

   C. Mathematical Treatment of Decay Phenomena

V. Properties of Radiation: Its Interaction with Matter

   A. Alpha Particles

   B. Beta Particles

   C. Gamma Radiation

VI. Radiation Detection Instruments

   Ion Collection; Ionization Chambers; Scintillation Devices; Nuclear Emulsions; Cloud Chambers

VII. Radiochemical Techniques

VIII. Radioisotopes in Biology

IX. Fundamentals of Nuclear Reactors

While the objective of the undergraduate course is principally to develop basic knowledge of theory and skills necessary for the student to read, with understanding, the basic technical literature and perform the basic laboratory procedures in this field; the graduate student would be required to perform graduate level laboratory experiments and/or research in the literature with the objective of developing advanced knowledge of theory, advanced skill in methods, and research capabilities. The topics chosen to assist in the development of advanced competencies would be arrived at through consultation between student and instructor. Suggested topics for graduate projects are:

1. Medical uses of radioisotopes
2. Uses of radioisotopes in high school chemistry laboratories
3. Advanced laboratory work with liquid scintillation counting
4. Advanced laboratory work with solid crystal scintillation spectroscopy
5. Industrial uses of radioisotopes
6. Physical and biological effects of nuclear weapons
7. Nuclear waste disposal
8. Isotopic tracers in biology

Evaluation of the additional graduate level objectives would be based on the laboratory reports and research papers written to satisfy the graduate requirements of the course.

# ADVANCED STRATIGRAPHY AND SEDIMENTATION

This proposed course is the graduate mate to the existing 1914.425 Stratigraphy and Sedimentation Course. The following topical outline is common to both these courses:

1. Introduction

    Scope of Stratigraphy and Sedimentation

2. The Stratigraphic Column

    Evolution of Stratigraphic Classification
    Present-day Classification
    The Stratigraphic Commission

3. Stratigraphic Procedures

    Outcrop Procedures
    Subsurface Procedures

4. Properties of Sedimentary Rocks

    Texture of Sedimentary Rocks
    Texture of Clastic Rocks
    Textural Elements of Nonclastic Rocks
    Mass Properties of Sedimentary Aggregates
    Color of Sediments
    Sedimentary Structures
    Composition of Sedimentary Rocks
    Chemical Composition of Sediments

5. Classification and Description of Sedimentary Rocks

    Modern Classifications
    Common Sedimentary Families
    Descriptions of Selected Clastic Sedimentary Rocks
    Nonclastic Sedimentary Rocks

6. Sedimentary Processes

    Weathering
    Transportation
    Classification of Stream Loads

Selective Transportation and Abrasion

Deposition of Clastics

Deposition of Nonclastics

Process and Response in Sedimentary Transportation and Deposition

7. Sedimentary Environments

    Importance of Sedimentary Environments in Stratigraphy

    Sedimentary Processes and Their Products

    Elements and Factors of the Environment

    Environmental Patterns

    Applications of Environmental Patterns in Stratigraphy

    Classification of Sedimentary Environments

    Post-depositional Changes in Sediments

    Reconstruction of Ancient Environments

8. Stratigraphic Paleontology

    Distribution of Organisms in Space

    Distribution of Organisms in Time

    Classification of Organisms

9. Stratigraphic Relationships

    Lithosomes

    Vertical Relationships

    Lateral Relationships

    Facies

10. Principles of Correlation

    Correlation of Lithostratigraphic Units

    Correlation of Biostratigraphic Units

    Time-Stratigraphy Correlation

    Correlation Charts

11. Sedimentary Tectonics

    Sedimentation and Rate of Subsidence

    Epeirogeny and Orogeny

    Development of Geosynclinal Theory

    Current Geosynclinal Theory

    Tectonic Cycles and Associated Igneous Activity

    Tectonics and Sedimentary Environments

12. Stratigraphic Maps

    Organization of Map Data
    Classification of Stratigraphic Maps
    Structure Contour Maps
    Isopack Maps
    Paleogeologic Maps
    Facies Maps
    Biofacies Maps
    Automatic Data Processing in Stratigraphic Maps

13. Stratigraphic Analysis

    The Concept of a Stratigraphic Model
    Lithologic Associations
    Clastic Associations
    Nonclastic Associations

While the objective of the undergraduate course is principally to develop basic knowledge of theory and skills necessary for the students to read, with understanding, the basic technical literature and perform the basic laboratory and field procedures in this discipline; the graduate student would be required to perform graduate level experiments and/or research in the literature with the objective of developing advanced knowledge of theory, advanced skill in methods, and research capabilities. The topics chosen to assist in the development of advanced competencies would be arrived at through consultation between student and instructor. Suggested topics for graduate projects are:

1. Paleocurrent velocities and directions derived from ripple mark analysis
2. Tectonic control of lateral variation of the Mauch Chunk formation
3. Distribution of particulate grain parameters as a determinant in species habitat selection.

Evaluation of the additional graduate level objectives would be based on the laboratory reports and research papers written to satisfy the graduate requirements of the course.

# PETROLOGY - PETROGRAPHY

This proposed course is the graduate mate to the existing 1914.430 Petrology and 1914.431 Petrography Courses. The following topical outline is common to the two undergraduate courses (taken as a pair) and the graduate course:

Petrology

A. Introduction

1. The nature and scope of petrology
2. Classification of rocks
3. Chemical composition of the earth's crust
4. Phase equilibrium and the phase rule

B. Discussion of theory and philosophy related to the igneous rocks

C. The sedimentary rocks

D. The metamorphic rocks

Petrography

A. Introduction to the petrographic microscope and its use

B. Review of the 19 most important rock forming minerals

C. The igneous rocks

D. The sedimentary rocks

E. The metamorphic rocks

The undergraduate courses may be taken separately, but the student is strongly advised to take the two concurrently. Petrology gives the student a thorough grounding in the theories and philosophies relating to the formation, classification, analysis, and description of the rocks. Petrography gives the student a basic knowledge of the uses and skill in using one of the more important tools of the geologist -- the petrographic (or polarizing) microscope. It also acquaints the student, by personal contact and examination (hands-on), with a full range of the rocks of the earth's crust, preparing the student for field work, laboratory work, and graduate work.

The graduate student is required to do library research in order to become familiar with the literature, and to prepare a paper on a topic relating to petrology agreed upon by the teacher and student. In addition to research in the literature, the graduate student will prepare a usable rock thin-section and present the microscopic description and analysis. The analysis will consist of a percentage determination of the mineral content and a chemical analysis based on the mineral content. Evaluation of the graduate student's performance in the proposed course will be based on the research paper and laboratory work done to satisfy the graduate requirements of the course.

TOPICAL OUTLINES

FOR THE

PROPOSED

UNDERGRADUATE (400 LEVEL) COURSES

# SCIENTIFIC GLASSBLOWING

This proposed course is the undergraduate mate to the existing 1901.500 Glassblowing course. The following topical outline is common to both these courses:

A. Cutting glass tubing, rod and capillary

1. Scratch and break method
2. Scratch and heat method
3. Glass saw method

B. Preparing test tube bottoms

1. 8-10 mm glass tubing
2. 25 mm glass tubing
3. Capillary tubing

C. Adjusting glass torch flame

1. Hand torch, variable tips
2. Hand torch, universal tip
3. Bench torch

D. Preparing straight seals

1. Tubing of same size
   a. Horizontal free hand
   b. Clamped horizontal
   c. Clamped vertical

2. Tubing of different size
   a. Horizontal free hand
   b. Clamped horizontal
   c. Clamped vertical

3. Capillary tubing

E. Preparing T Seals

1. Tubing of same size
2. Tubing of different sizes
3. Capillary tubing

F. Sealing Off Tubing Under Vacuum

1. Regular tubing
2. Capillary tubing

G. Preparing Bends

1. With hand torch
2. With ribbon burner

H. Preparing Ring Seals

1. Test tube bottom to tubing
    a. Concentric
    b. End to end

2. Inner flair to outer tubing

I. Preparation of Condensor

J. Preparation of Maze

The graduate and undergraduate courses have the same topical outline. They are both 1 S.H. skill development courses. The distinction between the two is that the undergraduate student is not expected to demonstrate proficiency in the several sizes of tubing as is the graduate student. (The difficulty of a glassblowing procedure increases in relation to the size of the tubing used).

## ADVANCED TOPICS IN CHEMISTRY

The proposed course is the undergraduate mate to the existing 1905.530 Special Topics in Chemistry course.

Advanced Topics in Chemistry is designed to present specialized topics in chemistry which are not ordinarily covered in our other courses. These topics will be presented by an expert in the field and will include the most recent developments in that area.

Topics might include those for which our present staff does not have the requisite expertise to teach, and would entail adjuncts from industry, government or other educational institutions. This course would be used to enrich and broaden the offerings available to our students. Examples include: Polymer Chemistry, Catalysis, Chemical Engineering for Chemists, Chemical Safety, Toxicology for Chemists, etc.

The undergraduate student would be expected to master the content of the particular topic(s). Evaluation would typically include performance on problem assignments, examinations, and where appropriate, an assessment of laboratory skills. Additionally, the graduate student in the existing course is expected to write a research paper on a topic chosen with the advice of the instructor.

CHEMICAL THERMODYNAMICS

This proposed course is the undergraduate mate to the existing 1908.550 Thermodynamics I course. The following topical outline is common to both these courses:

I. The Thermodynamics Laws

A. The First Law

1. Internal energy
2. Heat and work
3. Enthalpy
4. Applications

a. Isothermal expansions
b. Adiabatic expansions
c. Free expansions

5. Thermochemistry

a. Heat capacity values
b. Heats of reaction

B. The Second Law

1. Entropy

a. Relationship to probability
b. Relationship to other state variables
c. Criteria for equilibria
d. Radiation and Stefans Law
e. The calculation of entropy

C. The Third Law

1. Absolute entropies
2. Standard entropies
3. Free energy and chemical potentials

a. Conditions for equilibrium
b. Fugacity
c. Equilibrium constants

II. Applications of Thermodynamics

A. Real gases
B. Solutions

1. Ideal solutions
2. Real, dilute solutions
3. Nonelectrolyte solutions
4. Electrolyte solutions

C. Galvanic cells

D. Activity coefficients

E. Irreversible process

F. Surface effects

G. Systems involving gravitational fields

H. Systems involving electric or magnetic fields

I. Vaporization processes

J. Multicomponent systems

K. Hydrogen and helium at low temperatures

The requirements for the undergraduate student in this proposed course is to display sufficient mastery of the above content areas to enable him to read, with understanding, the basic technical literature in this field. Evaluation of student accomplishment would include performance on problem assignments and written examinations. The graduate student in the existing course is similarly evaluated, but is also expected to write a research paper, on a topic chosen in consultation with the instructor, with the objective of developing advanced knowledge of theory and research capabilities.

Possible topics for graduate projects include:

1. Measurements of thermochemical data for practical systems.
2. The relationship of the First and Second Laws of Thermodynamics to everyday phenomena.
3. Thermodynamics and eletroplating.
4. Limitations on energy production imposed by the Second Law of Thermodynamics.

INTRODUCTION TO BIOCHEMISTRY - Lecture only

This proposed course is the undergraduate mate to the existing 0414.540 Biochemistry I course. The following topical outline is common to both these courses.

1. Ph and Buffers
2. Cellular Morphology and Composition
3. Carbohydrates
4. Lipids and Membranes
5. Proteins
6. Nucleic Acids
7. Structure and Function of Enzymes
8. Biochemical Energetics
9. Carbohydrate Metabolism
10. Lipid Metabolism
11. Protein and Nucleic Acid Metabolism
12. The Tricarboxylic Acid Cycle
13. Photosynthesis
14. Biosynthesis of Carbohydrates and Lipids
15. Biosynthesis of Nitrogeneous Compounds
16. Metabolic Control

While the objective of this proposed undergraduate course is primarily to develop the basic knowledge of theory necessary for the student to read, with understanding, the basic technical literature in this field, the graduate student is required to perform graduate level research in the literature with the objective of developing advanced knowledge of theory and research capabilities. Evaluation of student accomplishment in the undergraduate course would include performance on written examinations. The graduate student in the existing course is similarly evaluated, but is also evaluated on the research paper written to satisfy the graduate requirement of the course.

# PLATE TECTONICS

This proposed course is the undergraduate analog of the existing 1914.530 533 Plate Tectonics and Crustal Evolution course. The topical outline for Plate Tectonics, given below, is extracted from the one for the graduate course; the main difference being that the graduate course outline is more detailed.

The objectives of the proposed course are virtually the same as those stated for the graduate course, except that students in the graduate course are required to do a graduate level research paper revealing a significantly greater depth of understanding of the mechanisms of Plate Tectonics and will be held responsible for a more thorough understanding of the modern interpretation of the role of Plate Tectonics in crustal evolution. In addition, the graduate student is expected to submit an abstract of his research paper to each student in the class and present a fifteen to twenty minute oral report based on the paper.

While the undergraduate student will be evaluated on the basis of his understanding of fundamentals (as revealed by scores on written tests directed to the topics listed in the following outline); the graduate student will be additionally evaluated on the basis of his research paper and oral report.

## TOPICAL OUTLINE

I. Evolution of the theory

   A. From Continental Drift to Seafloor Spreading - 17th to 20th Century.
   B. From Seafloor Spreading to Global Plate Tectonics - 1912 to Present.

II. Composition and Gross Structure of the Earth

   A. Core
   B. Mantle
   C. Crust

III. Crustal Features

   ntinents
   an Basins
   nental Margins

IV. The Crust-Mantle Boundary

A. Seismic Definition
B. Physico-Chemical Characteristics

V. Evidence of Seafloor Spreading

A. Continental
B. Oceanographic
C. Paleontologic

VI. Plate Boundaries

A. Spreading Ridge
B. Subduction Zone
C. Transform Fault
D. Triple Junction

VII. Hot Spots and Mantle Plumes

VIII. Plate Tectonics and Continental Drift

A. The Evidence
B. Plate Motion
C. Mechanics of Plate Movement

IX. Paleo-Plate Tectonics - Precambrian and Paleozoic Activities

X. The Break-up of Pangea

A. Gordwanaland
B. Laurasia

XI. The Opening of the Atlantic Ocean

XII. Problems and Interpretations

XIII. The Growth of Continents

A. Continental Shields
B. Stable Platform Regions
C. Mobile Belts